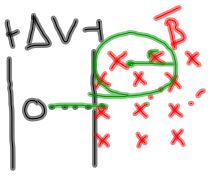
HW 17 Problem 11 Solution

p. 830 #11:



proton: $+e$, m_p

deuteron: $+e$, $2m_p$

alpha particle: $+2e$, $4m_p$

$$r_p = \frac{m_p v}{q_p B} \qquad q_p = +e$$

$$= \frac{m_p v_p}{eB}$$

$$\Delta K + \Delta U = 0$$

$$\frac{1}{2} m_p v_p^2 + q_p \Delta V = 0$$

$$v_p = \sqrt{\frac{-2 q_p \Delta V}{m_p}} \qquad q_p = +e$$

$$= \frac{m_p}{eB} \sqrt{\frac{-2e\Delta V}{m_p}}$$

$$= \sqrt{\frac{-2e\Delta V m_p^2}{e^2 B^2 m_p}} = \sqrt{\frac{-2\Delta V m_p}{eB^2}}$$

$$r_d = \frac{m_d v_d}{q_d B} \qquad m_d = 2m_p \qquad q_d = +e$$

$$= \frac{2m_p}{eB} \sqrt{\frac{-2e\Delta V}{2m_p}}$$

$$\Delta K + \Delta U = 0$$

$$\frac{1}{2} m_d v_d^2 + q_d \Delta V = 0$$

$$= \sqrt{\frac{-4m_p^2 e\Delta V}{e^2 B^2 m_p}}$$

$$v_d = \sqrt{\frac{-2e\Delta V}{2m_p}}$$

$$= \sqrt{\frac{-4\Delta V m_p}{eB^2}} = \sqrt{2}\sqrt{\frac{-2\Delta V m_p}{eB^2}} = \sqrt{2}\, r_p$$

$$r_\alpha = \frac{m_\alpha v_\alpha}{q_\alpha B} \qquad m_\alpha = 4m_p \qquad q_\alpha = +2e$$

$$= \frac{4m_p}{2eB} \sqrt{\frac{-e\Delta V}{m_p}}$$

$$\frac{1}{2} m_\alpha v_\alpha^2 + q_\alpha \Delta V = 0$$

$$v_\alpha = \sqrt{\frac{-2 q_\alpha \Delta V}{m_\alpha}}$$

$$= \sqrt{\frac{-4e\Delta V m_p^2}{e^2 B^2 m_p}}$$

$$= \sqrt{\frac{-2(2e)\Delta V}{4m_p}}$$

$$= \sqrt{2}\sqrt{\frac{-2e\Delta V m_p}{eB^2}} = \sqrt{2}\, r_p \qquad = \sqrt{\frac{-e\Delta V}{m_p}}$$